## **CLAIM AMENDMENTS**

This listing of claims will replace all prior versions, and listings, of claims in the application.

- 1 1. (Currently Amended) A method of determining whether a multi-component target 2 system meets a given multi-part performability requirement, the method comprising: 3 obtaining a description of the target system and failure probabilities for components of the target system that can fail independently, 4 5 obtaining a multi-part performability requirement for the target system, the multi-6 part performability requirement indicating desired performance levels for the target 7 system and corresponding fractions of time, 8 operating on a representation of the target system, providing producing a first 9 failure-scenario analysis of said target system using a computer-implemented failure 10 scenario generator module that receives as input the target system description and the 11 failure probabilities, the first failure-scenario comprising one or more states of the target 12 system having zero or more components failed and a corresponding probability of 13 occurrence of the one or more of the states of the target system, 14 modeling performance of the target system under the first failure scenario using a computer-implemented performance predictor module for generating a multi-part 15 16 performability function of said target system, the performance predictor module receiving 17 as input using said first failure-scenario analysis, 18 comparing said multi-part performability function with said multi-part 19 performability requirement, and 20 determining from said comparing whether said target system meets said multi-21 part performability requirement. 2. (Currently Amended) The method as set forth in claim 1, the step of comparing 1
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further comprising:

3	calculating if said first failure-scenario-analysis provides sufficient data for
4	generating a multi-part performability function determinative of target system
5	performance capability when compared to said multi-part performability requirements,
6	and
7	if so, proceeding with said step of determining, or
8	if not, providing a second failure-scenario analysis of said target system; and
9	repeating said steps of producing, generating, comparing, and calculating for
10	successive next failure-scenarios until a next failure-scenario analysis provides sufficient
11	data is obtained for generating a multi-part performability function determining
12	determinative of said target system performance capability when compared to said multi-
13	part performability requirements.
1	3. (Currently Amended) The method as set forth in claim 1, wherein said performance
2	predictor module also receiving as input a workload description multi-part performability
3	requirements are represented as one or more performance levels versus percentage of
4	time at each of said performance levels.
	4. (Cancelled)
1	5. (Currently Amended) The method as set forth in claim 1, the step of producing
2	operating on a representation of the target system comprising:
3	synthesizing a model of the target system based on predetermined individual
4	components of the target system wherein each of said components has a characteristic
5	failure specification.
1	6. (Currently Amended) The method as set forth in claim 5, further comprising the steps
2	of:
3	combining one or more said components of the target system as a macro-
4	component;
5	computing the failure probability of the macro-component as a function of the
6	failure probabilities of its respective one or more components; and

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using macro-components in said computing failure-scenario analysis.
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                  7. (Currently Amended) The method as set forth in claim 1, wherein the step of
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                 producing is performed providing a first failure scenario analysis of said target system
   2
                  comprises performing a failure scenario analysis in accordance with the following further
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   4
                  steps of:
                                      let "FP(c)" denote a probability that a system component "c" of the target system
   5
   6
                 will fail; then,
   7
                                      (1) Let "D" represent a failure-free system;
                                      (2) Let c_1, c_2, ..., c_m be components that can fail independently in D;
   8
   9
                                      (3) Let "sf" be the number of concurrent failures being considered in the
                                      last invocation (initially 0);
10
                                      (4) Let "s" be the ordinal number, among the scenarios with exactly "sf"
11
                                      failures, of the scenario returned in the last invocation (initially 0);
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                                      (5) If there exist exactly "s" scenarios with "sf" concurrent failures, then sf
14
                                      = sf+1: s = 0:
                                      (6) If sf \le mf, then s = s+1, otherwise exit;
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                                      (7) choose a_1, a_2, \dots a_{sf} (where a_i, i=1, \dots sf are different integers
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                                      between 1 and mf) such that there are exactly "s-1" scenarios with "sf"
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                                      concurrent failures more likely to occur than cal, ca2...casf;
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19
                                      (8) set sc = D with components c_{a1}, c_{a2}, ..., c_{asf} marked as failed;
                                      (9) set p = FP(c_{a1}) \times FP(c_{a2}) \times \dots \times FP(c_{a(sf)}) \times (1-FP(c_{bl})) \times \dots \times (1-FP(c_{bl})) \times (1-FP(c_{b
20
21
                                      FB(c_{b(mf-sf)}), where c_{bl}. C_{b(mf-sf)} are all the components that did not fail
22
                                     in "sc"; and
23
                                     (10) return (sc,p).
                 8. (Currently Amended) The method as set forth in claim [[1]] 2, the step of providing a
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   2
                 first failure scenario analysis of said target system further comprising:
                                      eliminating analysis of all failure scenarios grouping states together wherein said
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target system is non-functional in accordance with said multi-part performability

4 5

requirement, and

representing the grouped states in the multi-part performability function 6 eliminating analysis of all failure-scenarios wherein said target system is fully functional 7 8 in accordance with said multi-part performability requirement. 9. (Currently Amended) The method as set forth in claim [[8]] 2, the step of generating a 1 multi-part performability function comprising further steps of further comprising: 2 3 grouping states together wherein the target system is fully functional entering a multi-part performability function indicative of all failure scenarios wherein said target 4 5 system is non-functional; and 6 representing the grouped states in the multi-part performability function entering a 7 multi-part performability function indicative of all failure scenarios wherein said target 8 system is fully functional in accordance with said multi-part performability requirements. 10. (Currently Amended) The method as set forth in claim [[1]] 2, the step of providing 1 2 a first failure-scenario analysis of said target system comprising: 3 -wherein the failure-scenarios are computed repetitively entered based on 4 according to an order of likelihood of occurrence beginning with a most likely failure-5 scenario. 1 11. (Currently Amended) The method as set forth in claim 10, comprising the steps of: 2 if a multiplicity of like components having like failure probability and effect are 3 employed within said target system, treating said multiplicity of like components as a 4 single component of said target system. 12. (Cancelled) 1 13. (Currently Amended) The method as set forth in claim [[12]] 2, wherein repeating 2 the steps of producing, generating, comparing, and calculating for successive next failure-3 scenarios is performed in accordance with the following the step of verifying the equation 4 further comprising: 5 (1) set i = 1;

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(2) generate the next state S<sub>i</sub> and its occurrence probability
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 7
              OP(S<sub>i</sub>), from said step of generating the next failure scenario;
              (3) compute the performance U(S<sub>i</sub>) using [[a]] the performance predictor module;
 8
 9
      and
10
              (4) if,
11
                     \stackrel{\cdot}{\Sigma} \ OP(S_k) \ 1(U(S_k) \geq \ r_j) \geq \ f_j, \ \text{for all } j{=}1,2,\dots,n,
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13
              then the target system is capable of fulfilling the multi-part
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15
      performability requirements, exit and report; or
16
              (5) if,
17
                     18
19
20
              then the target system fails the multi-part performability
21
      requirements, exit and report; and otherwise,
22
              (6) set i = i + 1 and go to step (2).
      14. (Currently Amended) A computer readable media comprising computer code for
 1
 2
      implementing a method of determining whether a multi-component target system meets a
 3
      given multi-part performability requirement, the method comprising the steps of A
 4
      computer memory comprising:
 5
              computer code operating on a representation of the target system, providing
 6
      producing a first failure-scenario analysis of said target system, the first failure-scenario
 7
      comprising one or more states of the target system having zero or more components
 8
      failed and a corresponding probability of occurrence of the one or more of the states of
 9
      the target system;
10
             computer code providing a first failure scenario analysis of said target system;
11
              computer code modeling performance of the target system under the first failure
12
      scenario for generating a multi-part performability function-using said first failure-
13
      scenario analysis;
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14	computer code comparing said multi-part performability function with said
15	multipart performability requirements; and
16	computer code determining from said comparing whether said target system has a
17	capability of performing said multi-part performability requirements.
1	15. (Currently Amended) The memory media as set forth in claim 14, the computer code
2	eomparing-further comprising computer code for:
3	calculating if said first failure-scenario analysis provides sufficient data for
4	generating a multi-part performability first function determinative of predicting multi-
5	part performability when compared to said multi-part performability requirements, and
6	if so, proceeding with said step of determining; or
7	if not,
8	repeating the steps of producing, generating, comparing, and calculating for
9	successive next failure-scenarios until sufficient data is obtained for generating a multi-
10	part performability function determinative of the target system performance capability
l 1	when compared to the multi-part performability requirements
12	providing a second failure-scenario analysis of said target system;
13	repeating said steps of computing by generating a multi-part
14	performability next function;
15	comparing said next function with said multi-part-performability
16	requirement; and
17	
8	—————for generating a multi-part performability second function determinative of
9	predicting multi-part performability of said system when compared to said
20	— multi-part performability requirements.
1	16. (Currently Amended) The memory media as set forth in claim 15, the computer code
2	providing a first failure scenario analysis of said target system further comprising
3	computer code for:
4	eliminating all failure-scenarios grouping states together wherein said target
5	system is non-functional; and

6	eliminating all failure scenarios grouping states together wherein said target
7	system is fully functional in accordance with said performance requirements.
1	17. (Currently Amended) The memory media as set forth in claim 16, the code
2	providing a first failure scenario analysis of said target system further comprising:
3	—— <u>wherein</u> failure-scenarios are <u>computed</u> <del>repetitively entered based on</del> <u>according to</u>
4	an order of likelihood of occurrence beginning with a most likely failure-scenario.
	18. (Cancelled)
	19. (Cancelled)
	20. (Cancelled)
	21. (Cancelled)
1	22. (New) A computer system for determining whether a multi-component target system
2	meets a given multi-part performability requirement, comprising:
3	a failure scenario generator module for producing a first failure-scenario of the
4	target system from a description of the target system and failure probabilities for
5	components of the target system that can fail independently, the first failure-scenario
6	comprising one or more states of the target system having zero or more components
7	failed and a corresponding probability of occurrence of the one or more of the states of
8	the target system,
9	a performance predictor module for modeling performance of the target system
10	under the first failure scenario wherein a multi-part performability function of the target
11	system is generated from the performance predicted for the target system, the
12	performance predictor module receiving as input the first failure-scenario, and
13	a performability evaluator module for comparing the multi-part performability
14	function with a multi-part performability requirement for the target system, the multi-part
15	performability requirement indicating desired performance levels for the target system

- and corresponding fractions of time, and for determining from the comparison whether
- 17 the target system meets the multi-part performability requirement.
- 1 23. (New) The computer system as set forth in claim 22, wherein the performability
- 2 evaluator module determines whether the first failure-scenario provides sufficient data for
- 3 generation of a multi-part performability function determinative of target system
- 4 performance capability when compared to the multi-part performability requirements,
- 5 and
- 6 if so, the performability evaluator module proceeds with determining from the
- 7 comparison whether the target system meets the multi-part performability requirement, or
- 8 if not, successive next failure-scenarios are evaluated until sufficient data is
- 9 obtained for generating a multi-part performability function determinative of the target
- 10 system performance capability when compared to the multi-part performability
- 11 requirements.
- 1 24. (New) The computer system as set forth in claim 22, wherein the performance
- 2 predictor module also receives as input a workload description.
- 1 25. (New) The computer system as set forth in claim 22, wherein the performance
- 2 predictor synthesizes a model of the target system based on predetermined individual
- 3 components of the target system wherein each of said components has a characteristic
- 4 failure specification.
- 1 26. (New) The computer system as set forth in claim 22, wherein components of the
- 2 target system are combined as a macro-component and the failure probability of the
- 3 macro-component is computed as a function of the failure probabilities of its respective
- 4 components.
- 1 27. (New) The computer system as set forth in claim 22, wherein the failure scenario
- 2 generator operates in accordance with the following:
- let "FP(c)" denote a probability that a system component "c" of the target system

- 4 will fail; then,
- 5 (1) Let "D" represent a failure-free system;
- 6 (2) Let "c<sub>1</sub>, c<sub>2</sub>...c<sub>mf</sub> be components that can fail independently in D;
- 7 (3) Let "sf" be the number of concurrent failures being considered in the
- 8 last invocation (initially 0);
- 9 (4) Let "s" be the ordinal number, among the scenarios with exactly "sf"
- failures, of the scenario returned in the last invocation (initially 0);
- 11 (5) If there exist exactly "s" scenarios with "sf" concurrent failures, then sf
- 12 = sf+1; s = 0;
- 13 (6) If  $sf \le mf$ , then s = s+1, otherwise exit;
- 14 (7) choose  $a_1, a_2 \dots a_{sf}$  (where  $a_i, i=1, \dots$  sf are different integers
- between 1 and mf) such that there are exactly "s-1" scenarios with "sf"
- 16 concurrent failures more likely to occur than  $c_{a1}, c_{a2}...c_{asf}$ ;
- 17 (8) set sc = D with components  $c_{a1}, c_{a2}, ... c_{asf}$  marked as failed;
- 18 (9) set  $p = FP(c_{a1}) \times FP(c_{a2}) \times \dots \times FP(c_{a(sf)}) \times (1-FP(c_{bl})) \times \dots \times (1-FP(c_{bl})) \times (1-FP(c_{bl})) \times \dots \times (1-FP(c_{bl})) \times (1-F$
- FB( $c_{h(mf-sf)}$ ), where  $c_{hl}$ ... $c_{h(mf-sf)}$  are all the components that did not fail
- in "sc"; and
- 21 (10) return (sc,p).
- 1 28. (New) The computer system as set forth in claim 22, wherein states are grouped
- 2 together in which the target system is non-functional, and the grouped states are
- 3 represented in the multi-part performability function.
- 1 29. (New) The computer system as set forth in claim 22, wherein states are grouped
- 2 together in which the target system is fully functional, and the grouped states are
- 3 represented in the multi-part performability function.
- 1 30. (New) The computer system as set forth in claim 22, wherein the failure-scenarios
- 2 are computed according to an order of likelihood of occurrence.

- 1 31. (New) The computer system as set forth in claim 30, wherein if a multiplicity of like
- 2 components having like failure probability and effect are employed within the target
- 3 system, the multiplicity of like components are treated as a single component of the target
- 4 system.
- 1 32. (New) The computer system as set forth in claim 22, wherein the computer system
- 2 operates in accordance with the following:
- 3 (1) set i = 1;
- 4 (2) generate the next state  $S_i$  and its occurrence probability  $OP(S_i)$ ;
- 5 (3) compute the performance U(S<sub>i</sub>) using the performance predictor module; and
- 6 (4) if,

then the target system is capable of fulfilling the multi-part

11 performability requirements, exit and report; or

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12 (5) if,
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14  $\Sigma \text{ OP}(S_k) \ 1(U(S_k) < r_j) \ge 1 - f_j, \text{ for any } j = 1, 2, \dots, n,$ 

15 k=

then the target system fails the multi-part performability requirements, exit and

- 17 report; and otherwise,
- 18 (6) set i = i + 1 and go to step (2).